Clean Listing of Claims
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JCW

1. (currently amended) A hollow fiber membrane contactor comprising:

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein fluid being introduced into said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening, and a vacuum being applied via said first end cap opening;

wherein said shell, said first end cap, said second end cap, said center tube, said first tube sheet, said second tube sheet, and said plug are made from a same material.

2. (canceled)

3. (previously presented) The hollow fiber membrane contactor according to Claim 1, wherein said same material being polyethylene.

4. (original) The hollow fiber membrane contactor according to Claim 1, wherein said shell having a diameter of 4 inches (10 cm) or less.

5. (original) The hollow fiber membrane contactor according to Claim 1, wherein said shell having a length of 24 inches (60 cm) or less.

6. (original) The hollow fiber membrane contactor according to Claim 1, said contactor further comprising a baffle.

7. (currently amended) A system for degassing a liquid comprising:

a liquid under an elevated pressure;

a hollow fiber membrane contactor comprising;

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in

communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said fluid under the elevated pressure being introduced to said contactor via said second end cap opening, said fluid under the elevated pressure being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening;

wherein said shell, said first end cap, said second end cap, said center tube, said first tube sheet, said second tube sheet, and said plug are made from a same material.

8. (currently amended) A hollow fiber membrane contactor comprising:

a cartridge;

said cartridge comprising:

a perforated center tube having two ends;

a hollow fiber fabric surrounding said tube, said hollow fiber fabric comprising hollow fiber membranes, said hollow fiber membranes having a lumen;

tube sheets affixing said fabric to said tube at each said tube end; and

a plug located at one end of said tube;

wherein hollow fiber lumens being open at the tube sheet next to said plug and hollow fiber lumens being closed at the other tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

end caps having an opening therethrough;

said end caps being adjoined to said shell ends;

wherein one of said end caps and said tube sheet next to said plug defining a first head space therebetween where said end cap opening being in communication with said hollow fiber lumens via said first head sapce;

wherein said other end cap and said other tube sheet defining a second head space therebetween where said

end cap opening being in communication with said center tube via said second headspace;

wherein fluid introduced into said contactor via said opening in communication with said center tube being distributed across said hollow fiber fabric and exiting said contactor via said opening through said shell, and a vacuum being applied via said opening in communication with said hollow fiber lumens;

wherein said shell, said end caps, said center tube, said tube sheets, and said plug are made from a same material.

9. (canceled)

10. (previously presented) The hollow fiber membrane contactor according to Claim 8, wherein said same material being polyethylene.

11. (original) The hollow fiber membrane contactor according to Claim 8, wherein said shell having a diameter of 4 inches (10 cm) or less.

12. (original) The hollow fiber membrane contactor according to Claim 8, wherein said shell having a length of 24 inches (60 cm) or less.

13. (original) The hollow fiber membrane contactor according to Claim 8, said contactor further comprising a baffle.

14. (currently amended) A system for introducing a gas into a liquid comprising:

a liquid;

a gas under an elevated pressure;

a hollow fiber membrane contactor comprising;

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said gas under the elevated pressure being introduced into said hollow fiber lumens via said first end cap opening, and simultaneously said fluid being introduced to said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening;

wherein said shell, said first end cap, said second end cap, said center tube, said first tube sheet, said second tube sheet, and said plug are made from a same material.

15. (previously presented) The hollow fiber membrane contactor according to claim 1 wherein said shell opening being located at a midpoint between said two ends of said shell.

16. (previously presented) The system for degassing a liquid according to claim 7 wherein said shell opening being located at a midpoint between said two ends of said shell.

17. (previously presented) The hollow fiber membrane contactor according to claim 8 wherein said shell opening being located at a midpoint between said two ends of said shell.

18. (previously presented) The system for degassing a liquid according to claim 14 wherein said shell opening being located at a midpoint between said two ends of said shell.

19. (currently amended) A hollow fiber membrane contactor comprising:

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein fluid being introduced into said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid

then exiting said contactor via said shell opening, and a vacuum being applied via said first cap end opening.

20. (currently amended) A system for degassing a liquid comprising:

a liquid under an elevated pressure;

a hollow fiber membrane contactor comprising;

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said fluid under the elevated pressure being introduced to said contactor via said second end cap opening, said fluid under the elevated pressure being

distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening.

21. (currently amended) A hollow fiber membrane contactor comprising:

a cartridge;

said cartridge comprising:

a perforated center tube having two ends;

a hollow fiber fabric surrounding said tube, said hollow fiber fabric comprising hollow fiber membranes, said hollow fiber membranes having a lumen;

tube sheets affixing said fabric to said tube at each said tube end; and

a plug located at one end of said tube;

wherein hollow fiber lumens being open at the tube sheet next to said plug and hollow fiber lumens being closed at the other tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

end caps having an opening therethrough;

said end caps being adjoined to said shell ends;

wherein one of said end caps and said tube sheet next to said plug defining a first head space therebetween where said end cap opening being in communication with said hollow fiber lumens via said first head sapce;

wherein said other end cap and said other tube sheet defining a second head space therebetween where said end cap opening being in communication with said center tube via said second headspace;

wherein fluid introduced into said contactor via said opening in communication with said center tube being distributed across said hollow fiber fabric and exiting said contactor via said opening through said shell, and a vacuum being applied via said opening in communication with said hollow fiber lumens.

22. (currently amended) A system for introducing a gas into a liquid comprising:

a liquid;

a gas under an elevated pressure;

a hollow fiber membrane contactor comprising;

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said gas under the elevated pressure being introduced into said hollow fiber lumens via said first end cap opening, and simultaneously said fluid being introduced to said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening.